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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Relation of the Chassis Dynamometer to Motor Car Performance

The Quill or Needle Type Bearing

PUBLISHED BY

THE TEXAS COMPANY

TEXACO PETROLEUM PRODUCTS

The X-Ray machine of the petroleum industry

"MILES PER GALLON" is a big talking point in buying a car. And it is one of the important criteria of economical operation to the average owner. But the many factors that control this popular measure of a car's performance are little known beyond the laboratory and the proving ground.

Automotive manufacturers have given us a marvelous mechanical unit. The petroleum industry has contributed its part in making possible its efficient operation.

"Backstage" in the petroleum industry there is carried on the scientific research and experimental work that has so much to do with smooth car performance, engine life and "miles per gallon" economy.

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You will be interested in the Texaco Chassis Dynamometer and the intensive program of scientific and practical study at the Texaco Research Laboratories in Beacon, New York. Texaco always cooperates with the automotive industry.

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Relation of the Chassis Dynamometer to Motor Car Performance

SOME ten years ago we were just emerging from an era of fear as to how long the world's supply of petroleum would last. Eminent geologists and governmental agencies in many parts had predicted that at the amazing rate of consumption of very nearly three million barrels per day but a few years could pass before we would be forced to seek a substitute for gasoline. Then came the age of deep-well drilling with subsequent revival of apparently exhausted oil fields, and the extension of these methods of production to other areas theretofore regarded as barren. Today, as a result any possibility of a scarcity of gasoline for many years to come seems very remote.

It was during that period of worry as to the future supply of motor fuel that the Petroleum Industry undertook seriously to study motor car performance and to develop ways and means of simulating road conditions in the laboratory. Actual road tests had been run, of course, but they were costly as to time and expense, and, furthermore, the influence of individual drivers in the handling of cars, traffic difficulties, changes in air temperatures, and wind, were variables too important to be overlooked. Steps were, therefore, taken further to perfect the design of a machine on which a car could be run and tested at any speed, under any reasonable driving temperature, and exposed to variable wind velocity. Such a machine, known as the Chassis Dynamometer, had been thought of long before this period; in fact, the history of the automotive industry credits the earliest conception of the present day Chassis Dynamometer to the Automobile Club of America in New York City sometime around 1907-1908. Later, around 1915 the traction drums and power absorption parts of this installation, were presented to Yale University, where the late Professor Lockwood did some very valuable research in testing practically all the cars on the American market.

In gasoline engine research the word "dynamometer" has been used very extensively. In such work, however, it applies to an electric dynamo or generator driven by the engine under test, with means for dissipating the absorbed power and a variety of other controls and many gauges to enable observation of power output under variable loads and at varying speed.

As applied to the automobile as a whole, however, the word "dynamometer" has a broader meaning. Here it involves an apparatus by means of which the performance of an automobile can be thoroughly investigated, and tests run under conditions similar to those encountered in actual road operations; yet entirely free from the drawbacks incident to road test work where it is difficult to control the speed, where grades vary constantly and

where it is virtually impossible to take accurate readings of power, acceleration and temperatures. In this regard it is important to remember that laboratory instruments usually give more accurate readings than the portable type.

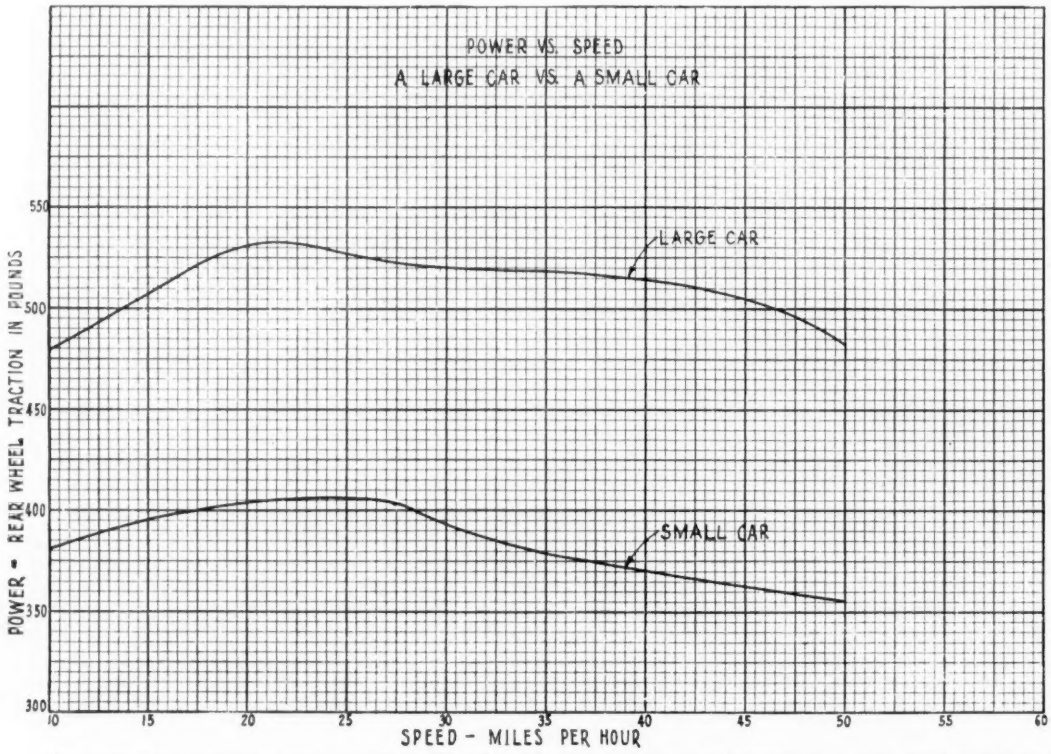


Fig. 1—Showing full throttle power for speeds up to 50 miles per hour in terms of rear wheel tractive force, as developed on The Texas Company Beacon, N. Y., Research Laboratory Chassis Dynamometer for two popular 1935 cars.

The Chassis Dynamometer has definitely proved that it is entitled to mention as one of the outstanding types of testing machinery developed for automotive research work. In addition it is unique in that the data which it is capable of developing has a very definite interest to every motor car owner. Consider this from the angle that one can obtain information as to:

a. Fuel consumption in miles per gallon, under level road conditions at all speeds;
b. The maximum car speed under level road conditions;
c. The grade which can be climbed at any car speed, and the miles per gallon of gasoline at each speed;
d. The proper carburetor setting for any specific set of operating conditions; this is determined either by exhaust gas analysis or by direct measurement of the fuel and air consumed;
e. The possibility of vapor locking, by measurement of the gasoline temperature at various points in the fuel system for any specific range of atmospheric temperatures;
f. The anti-knock requirement of the gasoline used by any car;
g. Whether power and acceleration can be increased by spark advance and the use of higher anti-knock gasoline; many automobile engines are so designed that any observation of the change in spark advance with operating conditions by means of a Neon tube, require the operator to work in the engine compartment or under the car. This would preclude the possibility of conveniently making such tests on the road.
h. Crankcase lubricating oil temperatures, under any specific atmospheric condition, as a guide to the most suitable viscosity for any type of car;
i. The rate of oil consumption;
j. The temperature of the differential, transmission and over-drive lubricants;
k. The frictional horsepower of the engine and chassis at various speeds; and
l. The accuracy of the speedometer, inasmuch as this indicates the car speed as a function of the R.P.M. of the rear wheels.

This is a wide range of objectives; a range in fact which would normally be virtually impossible of attainment unless thousands of hours of road testing and many cars were involved. The Chassis Dynamometer makes this possible, however, in but a fraction of the time, with far less labor, and the use of but a few cars for standardization purposes. In other words, when a new model, popular priced car is put on the market, its power capabilities, hill-climbing ability, range of fuel and lubricating oil economies, anti-knock requirements, and vapor-locking tendencies can be determined on the Chassis Dynamometer almost as soon as it is off the production line.

DESCRIPTION OF THE DYNAMOMETER

The Chassis Dynamometer at the Beacon, N. Y., Research Laboratory of The Texas Company, is shown in the accompanying illustration. In operation a car to be tested is run into the test room and onto weighing scales which show the weight of the car, from which the maximum grade it can climb can be computed from the "draw-bar pull" developed at the traction drums after dividing by the car weight.

After weighing it is then moved forward and onto these drums until its rear wheels rest directly over the vertical center line. It is, of course, essential to anchor the car securely throughout the test period and to hold its rear wheels in fixed position with respect to the drums. This is accomplished by means of four wire cables attached to the rear axle near the spring clips. Two of these cables hold against forward motion and two against any motion to the rear. Each pair of cables is provided with an equalizer so that the load on each end of the axle will be equal; and yet, the equalizers are so short that breakage of any cable would permit the car to move only an inch. From these equalizers two $\frac{3}{8}$-inch cables pass over small drums which can be tightened through an irreversible worm gear from a hand wheel located at the side of the car. Fore and aft adjustment where necessary can be made through turnbuckles located between the main cables and the equalizers.

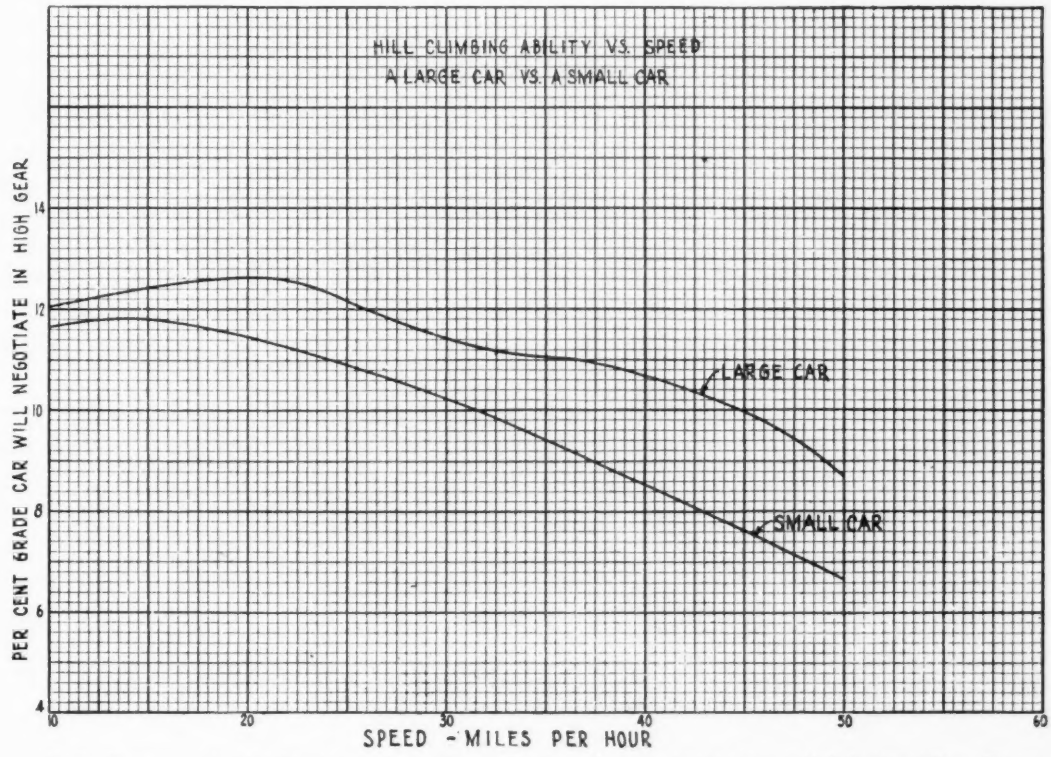


Fig. 2—These curves show full-throttle power for speeds up to 50 miles per hour translated into terms of hill climbing ability. The comparative performance of the two cars is interesting. The large car with 20% greater engine displacement and weighing 26% more than the small car, develops 39% greater traction at 40 miles per hour which enables it to negotiate a 24% steeper grade as measured on the Chassis Dynamometer.

Design of the Traction Drums

The drums on which the rear end of the car rides are operated by the rear wheels. They have a circumference of 211.2 inches, which is equal to 1/300 of a mile. As a result, 300 revolutions per minute is equivalent to 60

miles per hour. The corresponding diameter is approximately 5 feet, 7¼ inches and the width of each drum is 20⅜ inches. These drums are made of compressed fibre strengthened and weighted with cast iron rings and weigh approximately 3500 pounds each. The allows for a weight of about 3,000 pounds. Since only approximately half the weight of the car is on the rear wheels a car weight of 6,000 pounds can be accommodated. The rated torque of the pinion shaft and gear corresponds to continuous rear wheel tractions

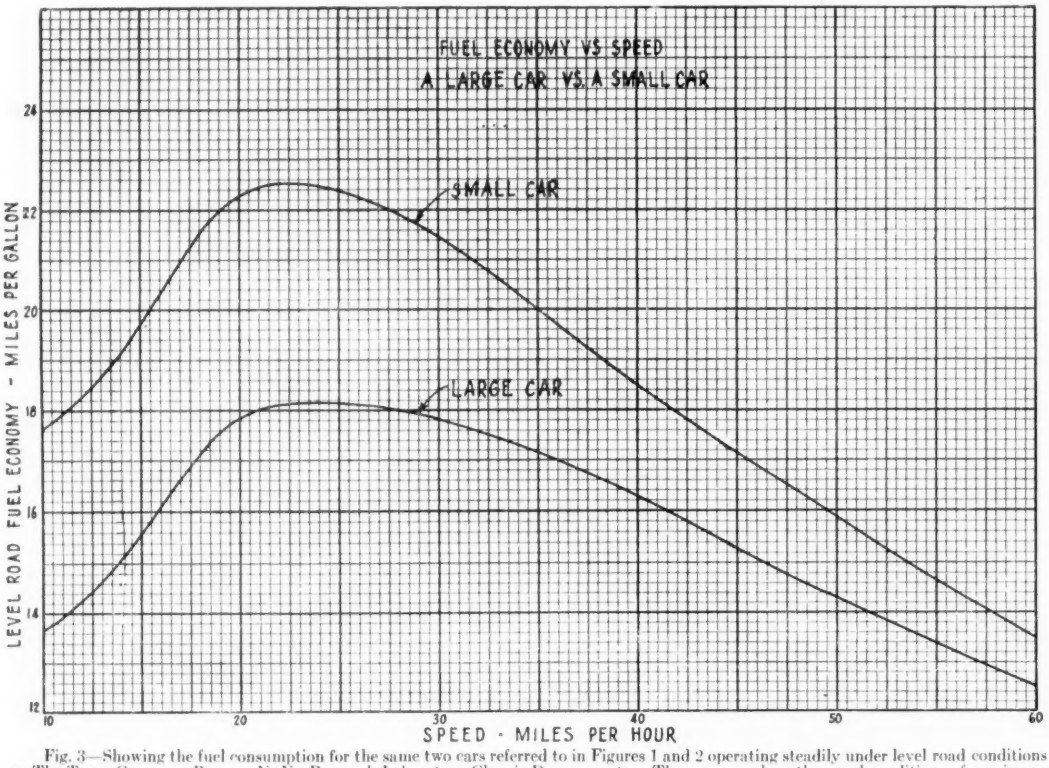


Fig. 3—Showing the fuel consumption for the same two cars referred to in Figures 1 and 2 operating steadily under level road conditions on The Texas Company Beacon, N. Y., Research Laboratory Chassis Dynamometer. These curves show the usual conditions of maximum operating economy between 20 and 30 miles per hour with a rapid increase in fuel consumption as speed increases.

mass of the rims has been figured to enable acceleration testing at the same rate as for a 3600-lb. car. For a car of different weight than this, a correction is made to the acceleration data, which is proportional to the weight. The drums are spaced 56½ inches from center to center, which distance will accommodate cars having treads from about 42 to 71 inches.

The drums are mounted on a spiral bevel, Timken axle having a 4.5 to 1 reduction ratio. In the test operation the power developed by the car is transmitted through the rear wheels to the drums and from thence to the axle. This latter in turn transmits power through a regular truck propeller shaft and gear box to a 150 H.P. electric generator and then through a second propeller shaft, axle assembly and belt connection to a large centrifugal fan or blower. The second axle is used to simplify the fan drive and belting arrangement, and to reduce the speed of the propeller shaft.

The drum axle is rated for an 11,000 pound load, which, after deducting the drum weight of 700 pounds with a maximum of several hundred pounds greater for short periods. The axle housing is supported on ball bearings and its reaction torque is taken up by a fabricated triangular beam through suitable linkages connected to a Howe "weightograph." This beam extends eight feet on each side of the axle and is weighted at each end with a mass of about 220 pounds to reduce "hunting." Exact balance is attained by adding or removing steel washers to or from a container welded to one end. This balance must be made independently of the scale linkage because of the use of a reverse linkage which gives positive scale readings regardless of the direction of traction.

WINDAGE AND TEMPERATURE CONTROL

Wind velocities comparable to road service are attained by operation of the centrifugal fan or blower which blows air over the front of the car under test. The operating speed of the fan with respect to the speed of the traction

drums is such that at any car speed the velocity of the air striking the front of the car will be very nearly the same as the actual speed the car is making on the drums. This assures cooling of the radiator and especially the engine oil pan equivalent to that of running at the same speed on the road.

The size of the fan has been carefully determined so that the power required to drive it at any speed is practically the same as the power required to drive a car against still air at the same speed. It is interesting to note that the power required to overcome wind resistance is very nearly the same for any type of car, inasmuch as the width and height, regardless of style is, after all, dictated by the size of the average person; thus the frontal area of all cars is surprisingly uniform. Furthermore, the "streamlining" of recent cars has made very little difference in the power required to overcome wind resistance.

In realization of the fact that temperature control of the air used for cooling purposes is highly important, provision has also been made to deliver this air at any atmospheric temperature up to 130 degrees Fahr. In operation, the air passing to the fan can be taken directly from outdoors, or re-circulated from the room through a grating in the floor and over banks of steam radiators, if necessary, prior to passage to the fan. The amount of steam supplied to these radiators is regulated by a throttle valve located near the station of one of the operators.

Positive control of air is made possible by operation of two sets of sliding doors, one of which can be used to regulate the amount of air re-circulated through the steam radiators, the other being arranged to open the fan suction directly to the outside fresh air. Both these sets of doors can be controlled by the operator at the same station as the steam throttle valve, at which point the temperature of air being directed against the car is indicated by a thermometer magnified by a suitably located lens.

FACILITIES FOR HANDLING POWER

Under normal "level-road" testing no use is made of the electric motor-generator; here it functions as merely a part of the propeller shaft through which mechanical power is transmitted from the traction drums to the fan. By suitable control of the energy absorbed, however, additional power can be demanded from the car comparable to requirements in hill-climbing. In other words, the unit is then functioning as an electric generator in order to absorb any excess of power above that required to drive the fan. This will normally represent the power available for acceleration.

As a motor this unit in turn can be used to start the car, and as a means of measuring the power required to roll the rear wheels. The power absorbed by friction in the various driven elements of a car can also be determined. By using the dynamometer to drive the car it is possible also to obtain the compression pressures in each cylinder for each throttle setting, and at each speed. By motoring the dynamometer the engine of a new car can also be "broken in" by external power.

The normal power which can be absorbed by this unit as a generator is around 200 H.P. at a maximum car speed of 90 miles per hour. The fan or blower in turn requires an additional 100 H.P. at this same speed; as a result a total of some 300 H.P. as developed by the car under test can be absorbed. When higher tractions are needed than those available from the fan and generator combined, a speed reduction can be used through the transmission located between the main propeller shaft and the generator.

All power readings indicative of the power transmitted are expressed in terms of traction or "draw-bar pull" at the rear wheels of the car. The traction force is read directly in pounds from a scale located so as to be visible to the driver; it is converted from the torque reaction of the axle housing which carries the drums. The principle involved is based on Newton's law to the effect that "for every action there is an equal and opposite reaction." This principle is also made use of in all cradle mounted dynamometer installations. No differential action is desired in the drum axle of the Chassis Dynamometer however, hence the respective axles are rigidly connected.

Fuel Control

To expedite test procedure and enable rapid observation of comparative car performance on a wide range of fuels, suitable valve controls are provided whereby tests can be run in sequence on eight different gasolines. Development of the methods of test have indicated the advisability of having each grade of fuel possess a different octane rating, within a range of from 40 to 80, for the purpose of definitely ascertaining the anti-knock value required for the type of car under test. The gasoline flow rate to the engine is also accurately measured in order to facilitate recording the fuel consumption in terms of miles per gallon. The air-fuel ratio is determined by exhaust gas analysis, using either a conventional Orsat apparatus or an electric CO_2 recorder.

It is obvious that in this way the Chassis

Dynamometer can be positively made to become of very pertinent interest to the motor car owner. Furthermore, it is proof to him of the active thought which is being given by the petroleum industry, to his operating economy and driving comfort. The results as to fuel consumption and anti-knock value necessary are then assembled and made the basis of actual refinery procedure in producing the most suitable gasolines commensurate with modern engine design and driving requirements.

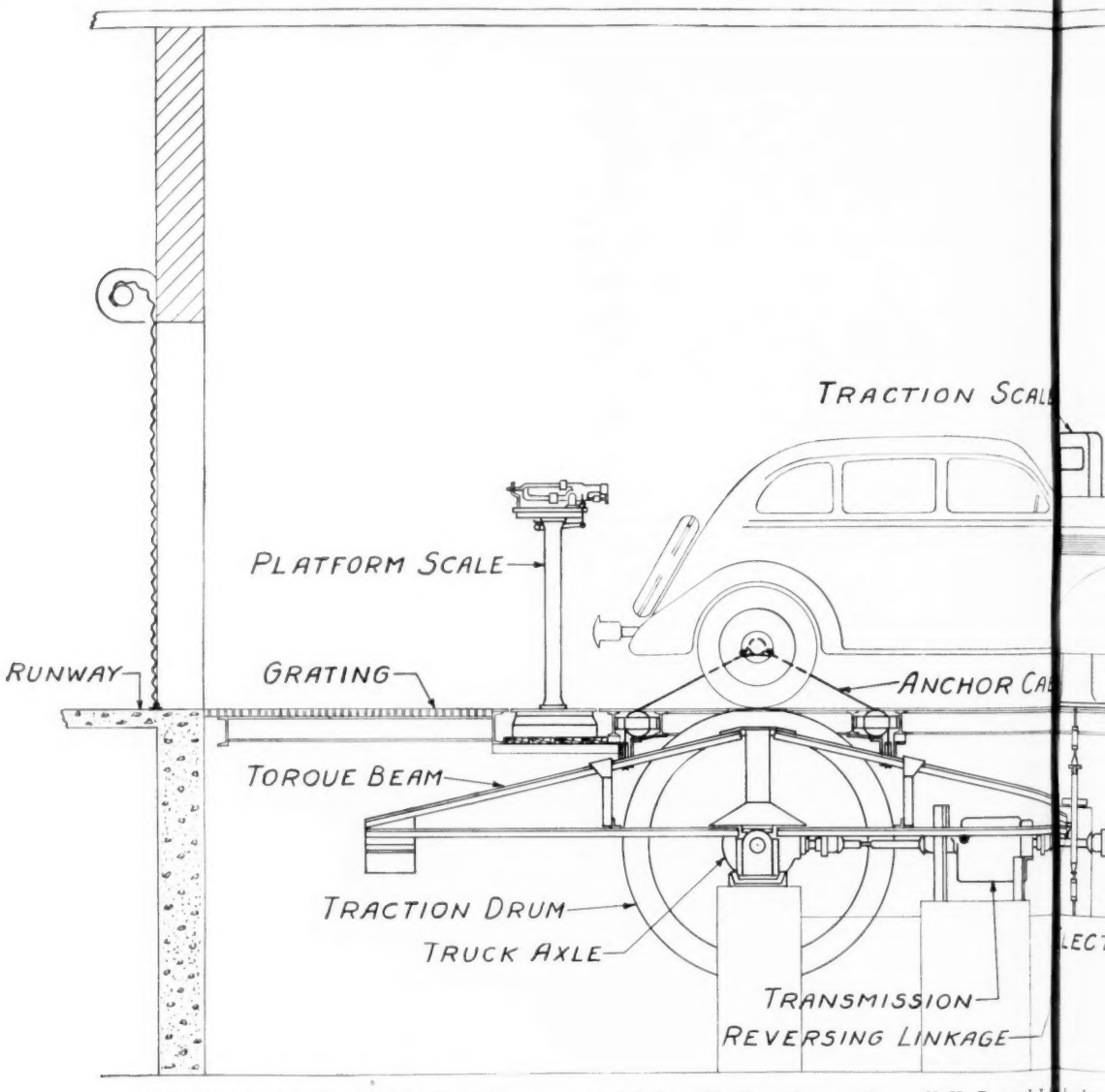


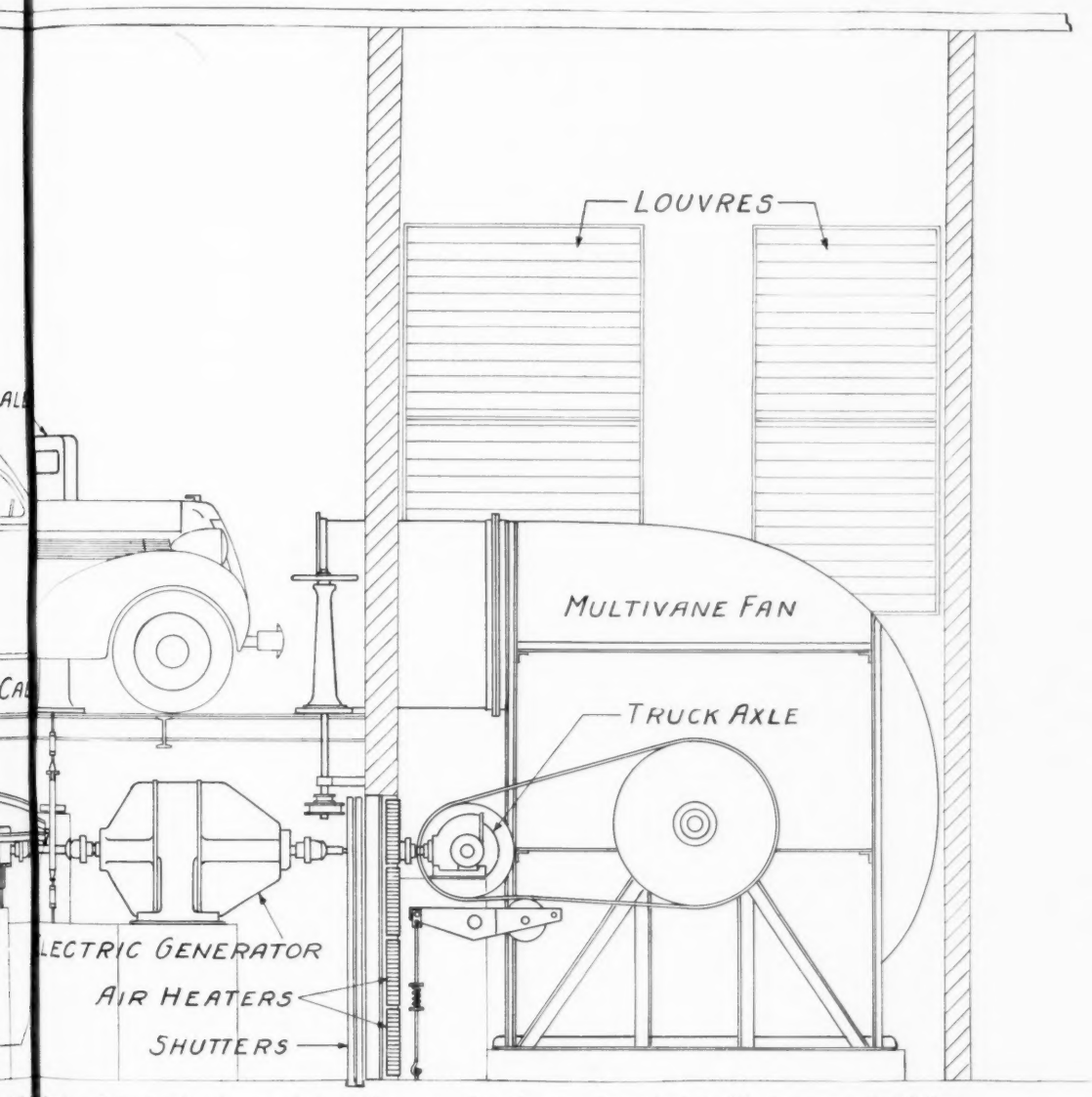
Fig. 4—Line sketch in elevation of the Chassis Dynamometer installation at The Texas Company Beacon, N. Y., Research La showing

VAPOR LOCK

In connection with fuel control and gasoline studies, provision is also made to observe the vapor-locking tendencies of all cars tested. The term "vapor lock" is generally understood to mean—any interruption in the normal operation of an automotive engine that is caused by vapor formation in the fuel supply or metering system. This is a very disturbing occurrence to the average motorist, especially in warm weather, when it may be necessary to idle his engine for considerable periods of time in congested traffic. If vapor-locking occurs his engine may stall, and until the accumulated fuel vapors in the carburetor intake are dissipated, he will have difficulty in starting again.

The fuel control equipment on the Chassis Dynamometer therefore includes a number of

thermo-couples or resistance thermometers located at the carburetor and at other important points in the fuel supply system adjacent to the engine, for positive determination and recording of fuel temperatures. These are desired to compare with the boiling temperatures of the average gasoline. See Fig. 5.



ch La showing relative location of a car under test with respect to the various operating mechanisms of the dynamometer installation.

Any gasoline that boils at the temperature existing in the fuel system of a car will cause vapor lock if at the existing temperature it forms more vapor than the fuel system can handle, without interrupting the flow of liquid gasoline enough to affect engine operation. The occurrence of vapor lock is, therefore, governed by three factors.

1. Temperatures existing in the fuel supply system;
2. The ability of the fuel system as stated above to handle any resultant vapor without interrupting the flow of liquid gasoline and affecting engine operation;
3. The tendency of the gasoline to form vapor when subjected to temperatures comparable with those encountered in the car fuel system. It is obvious that this latter must be given careful consideration in warm weather operations.

Builders of automotive engines have been fully aware of the serious and disturbing consequences which may result if vapor locking occurs on the road. Few, however, have taken

active steps to correct this by consideration of the relation to design and fuel line layout. Some research authorities, furthermore, who have been studying this subject, have confined their experiments to vapor lock during steady running, with but little regard for the more acute effects which might result when the engine is idled. It has been found that when a car is stopped the temperature in the fuel system will immediately start to rise; in most instances the maximum temperature may not be reached for from five to fifteen minutes after the car has been stopped. Under conditions of steady running it has been found that the car speed has very little effect on the fuel line temperatures, probably because at higher speeds the greater amount of heat developed by the engine is compensated for by the increased amount of air passing through the radiator. As would be expected also, increasing the load on an engine, equivalent to hill climbing, causes higher fuel line temperatures; likewise the higher the air temperature at which a car is operated the higher will be the fuel line temperature.

To date the problem has had to be shared jointly by the engine manufacturers and the petroleum industry, the former from a mechanical and design point of view, the latter in regard to the physical and vapor forming tendencies of gasolines when subjected to higher temperatures. Unfortunately correction of design in the interest of lower fuel system temperatures has been very much neglected.

Research has indicated that in practically all cars any satisfactory type of gasoline will have a tendency to boil in the carburetor bowl during idling. It is a very unfortunate condition since it is obvious that when an engine is started again the light fractions which are lost by boiling after the previous run, will be absent and, of course, it is these light fractions in the fuels which greatly assist in easy starting when the engine is cold. Furthermore, if the gasoline is boiling during steady running conditions, as will often be the case with any car operating on extremely warm days, the loss of light fractions will not only cause an increase in the fuel consumption, and probably a perceptible loss in the anti-knock value of the remaining gasoline which reaches the cylinders, but it may also develop an appreciable fire hazard. For these reasons every effort should be made to stress the desirability of reducing fuel line temperatures as far as possible.

The structural details in this regard have included studies of carburetor design to provide a system of venting which would adequately accommodate the amount of vapor which might be formed.

The Chassis Dynamometer has afforded an ideal means for the study of vapor lock in enabling:

1. The accurate determination of temperatures in all parts of the fuel system under road conditions of speed, load and air temperature.

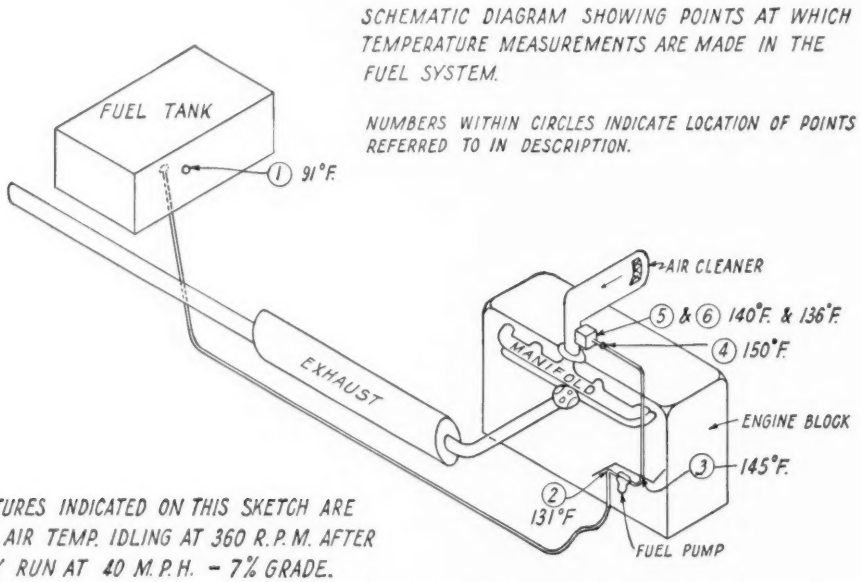

SCHEMATIC DIAGRAM SHOWING POINTS AT WHICH TEMPERATURE MEASUREMENTS ARE MADE IN THE FUEL SYSTEM.
NUMBERS WITHIN CIRCLES INDICATE LOCATION OF POINTS REFERRED TO IN DESCRIPTION.
FUEL TANK
1 91°F.
AIR CLEANER
5 & 6 140°F. & 136°F.
4 150°F.
MANIFOLD
EXHAUST
ENGINE BLOCK
3 145°F.
2 131°F
FUEL PUMP
TEMPERATURES INDICATED ON THIS SKETCH ARE FOR 75°F. AIR TEMP. IDLING AT 360 R.P.M. AFTER A STEADY RUN AT 40 M.P.H. - 7% GRADE.

Fig. 5—A typical automotive engine fuel system. In the study of vapor locking tendencies on The Texas Company Beacon, N. Y., Research Laboratory Chassis Dynamometer, fuel temperatures are normally taken at (1) the main fuel tank, (2) the fuel pump inlet, (3) the fuel pump outlet, (4) the carburetor inlet, (5) the carburetor bowl and (6) the main fuel jet.

2. The determination of the point at which vapor lock occurs, and
3. The effect of different types of fuels in overcoming vapor lock.

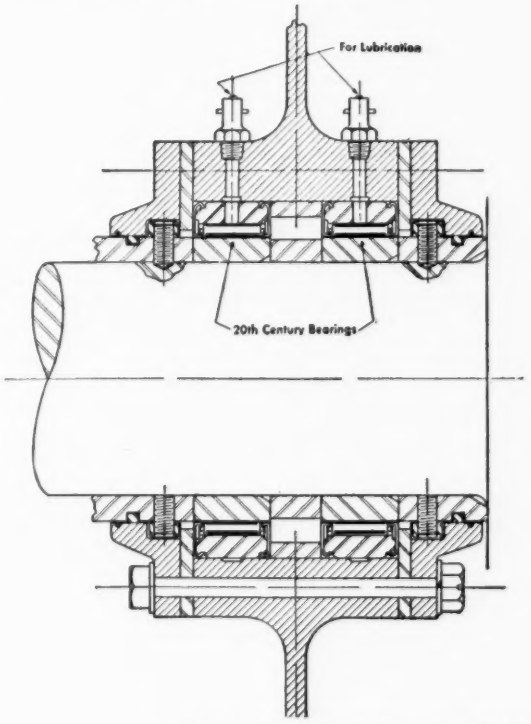
Unfortunately, due to engine carburetor design and location of the fuel lines it is normally essential to study the vapor handling capacity of any engine to be tested as an individual problem inasmuch as there is a direct tie-up between the temperatures which may occur in operation and the vapor forming characteristics of the fuel.

A recent test has developed some interesting figures in this regard, viz: with 75 degrees air, the temperature of the gasoline at the fuel pump outlet was 158 degrees Fahr., when running the car at 40 miles per hour under a fairly heavy load. It is interesting to note that when the car was brought down to idling from this speed the fuel pump outlet temperature went up to 180 degrees Fahr. With an air temperature of 100 degrees Fahr., which would be representative of summer driving conditions, the fuel system temperature was found to rise to 208 degrees Fahr., at the fuel pump outlet. It is, of course, obvious that it would be impracticable to furnish a gasoline which would not boil under these extreme conditions, and yet the car under test did not show any marked tendency toward vapor lock under these unusual high temperatures. This, however, was due to the fact that the carburetor was vented to a sufficient degree to accommodate the inordinately large amounts of vapor which must have been formed in the fuel system. This accomplished the desired result in one respect. On the other hand, it would normally be reflected by a corresponding decrease in the fuel economy in actual road service. This explains why certain cars may show a decrease in mileage in warm weather.

During very warm weather it is quite possible that liquid gasoline might even be forced out of the carburetor in a sufficient quantity to make a combustible mixture in the hood space of the car. With the various possible sources of probable ignition this might be expected to lead to a fire. For the purpose of elimination of fire hazard it would, therefore, seem advisable to recommend that a vent line be led from the carburetor bowl to a point below the engine to carry all fuel components away from the zone of the probable ignition. Study has also been given to fuel pump shielding in an effort to reduce the heat transmitted to the fuel at this point.

The Quill or Needle Type Bearing

CERTAIN types of machine operations require comparative flexibility in bearing design to permit of interchange to meet specific conditions. Until recently the designing engineer has been restricted to rather definite limitations of bearing surface and load conditions, which placed the sleeve-type plain bearing and the ball or roller bearing in distinct classifications. To the foresight of certain manufacturers of roller bearings may be attributed a departure from this trend, through their development of the so-called quill or needle type bearing and its successful application to a variety of operations of rotating or reciprocating nature, in the interest of reducing lubrication problems. Interchange of this nature has been found to be particularly beneficial where considerable heat may be developed; where cooling, or radiation of the heat cannot be readily brought about; and where circulation of adequate lubricant to develop a cooling effect may be difficult. Low initial cost and ease of application are further advantages which have been developed. The manufacturers also claim a high degree of accuracy, maximum capacity within the minimum space and ability to carry comparatively heavy loads.



Courtesy of Roller Bearing Company of America

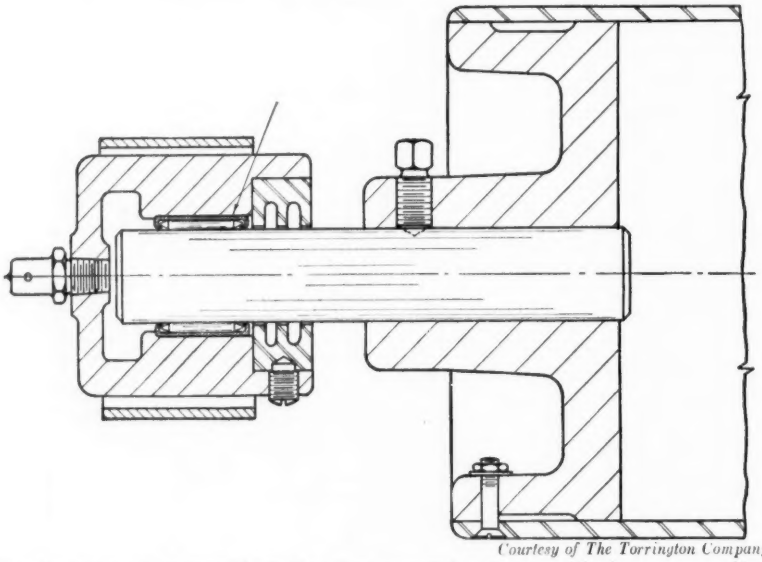
Fig. 6—Showing the application of a 20th Century Bearing to the main axle of a heavy duty earth moving wagon similar to a tractor front wheel.

Principles of Design

The quill or needle type bearing is akin to the

more conventional type of cylindrical roller bearing in that it comprises an outer race which houses the rolling elements, and retains them in fixed position with respect to one another. There is a marked difference, however, in that the rollers are of considerably smaller diameter, and the bearing assembly can be used with or without an inner race. When this latter is eliminated the bearing rolls are in direct contact with the shaft or journal; in such an installation the surface of the shaft serves as the inner race. This is the usual manner of installing such bearings provided the shaft can be hardened and ground. Otherwise, a specially hardened and ground inner race is used.

The principle involved in this design is based on the success which for years attended the use of straight rollers for bearing service on certain types of industrial machinery, and the improvements in heat treating and low cost quality production of small diameter rolls capable of carrying heavy loads by virtue of the uniformity of their metallic structure and hardness. Until comparatively recently, however, bearings of this type were built up, and while they normally were full complement in design and afforded maximum roll surface within minimum space, they were not self-contained or designed for unit installation. The quill or needle type bearing, by including this advantage, adds a distinctive type of self-contained device to the assembly of equipment available to the machine designer. It will normally fall into its own classification and rarely will it overlap the field of service of other conventional types of bearings, being applicable as it is to operations where these designs have not functioned with entire success.

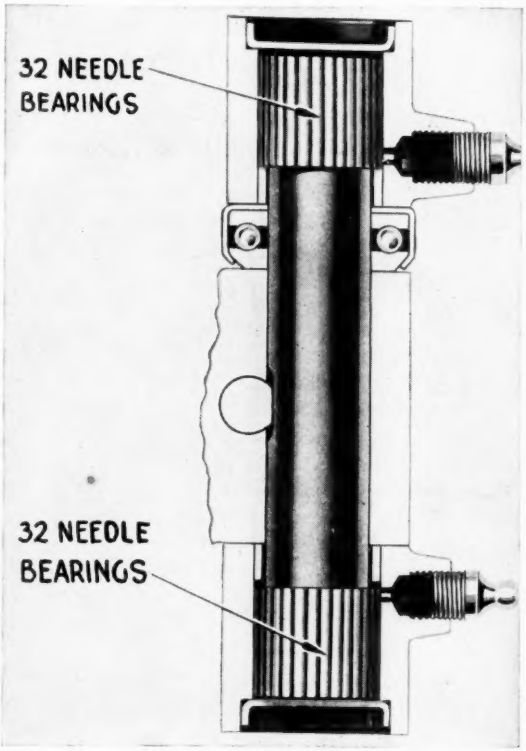


Courtesy of The Torrington Company

Fig. 7—Showing a Torrington Needle Type Bearing applied to the return idler for a conveyor. Note means of lubrication through end of bearing cap; also that the bearing housing acts as a reservoir for lubricant.

Maintenance of Lubrication

Bearings of the quill or needle type present a combination of sliding and rolling motion which is regarded as being an adjunct to lubrication. In other words, when a shaft revolves within such a bearing the individual rolls of the bearing do not revolve at a speed in direct ratio to the speed of the shaft. As a result, theory indicates that along the actual surfaces of contact boundary lubrication is approached. Revolution of the rolls of the bearing, however, prevent actual impairment of the lubricating film by constant renewal of this latter. Certain authorities con-



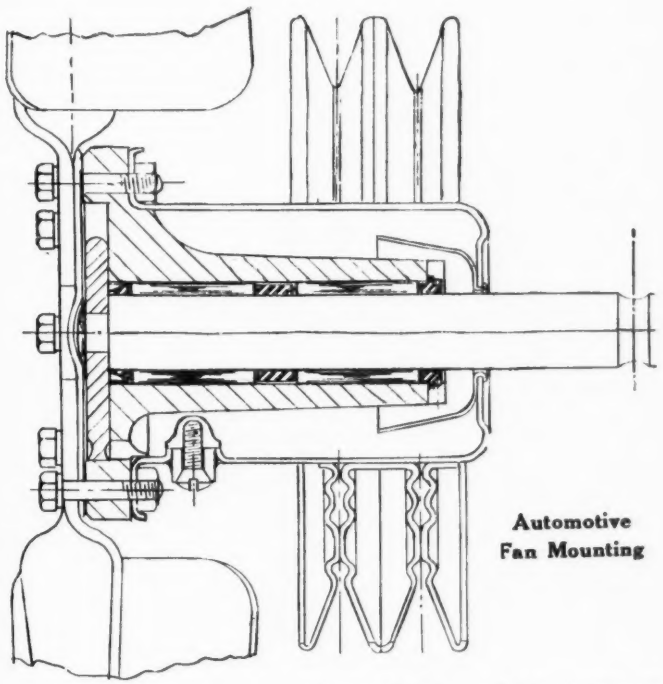
Courtesy of Chevrolet Motors Company

Fig. 8—Showing a Hyatt Needle Type Bearing as applied to the steering and knee-action suspension in the Chevrolet automobile.

tend that this is brought about by a more-or-less pumping action which is developed by each roll as it passes through the lubricant in the housing, with the result that a freshly lubricated surface on each roll is continually being presented to the revolving surface of the shaft.

The manufacturers of such bearings also contend that positive lubrication can be assured with minimum development of heat at high speed, on account of the very small amount of churning of the lubricant which is developed due to the intimate contact of the rolling elements and the smooth training of the lubricant, provided that the bearing is not charged with too much lubricant. It is obvious that the body, or consistency, of the lubricant will also be a factor in this regard. Heavier bodied products are frequently more susceptible to churning and development of internal friction.

For this reason, the design is frequently studied to enable oil lubrication as, for example, where such bearings are used for automotive type universal joints. This will also be practicable where the quill or needle bearing is used in place of the sleeve type bearing on Diesel or internal combustion engine wrist pins. Such installations do not call for any oil-tight type of housing.

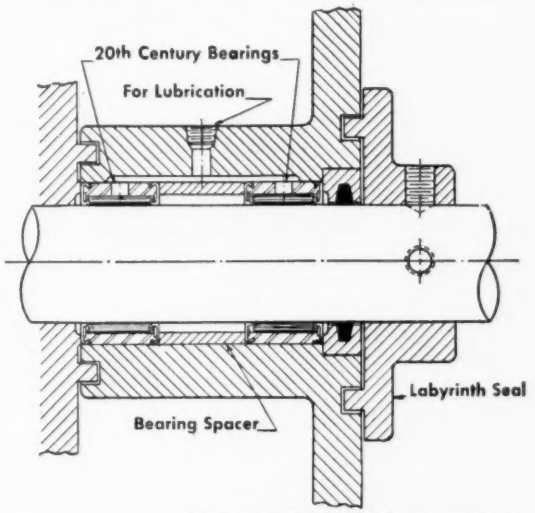


Courtesy of The Bantam Ball Bearing Company

Fig. 9—Showing the Bantam Quill Type Bearing installed on an automotive fan mounting.

On the other hand, for industrial applications a medium consistency grease may be most practicable, especially where inclusion of special means for sealing may be prohibited due to the increased cost.

Where grease is used it is, of course, essential



Courtesy of Roller Bearing Company of America

Fig. 10—Showing how the 20th Century Bearing can be mounted in a housing and run directly on a hardened and ground shaft. Note method of sealing; also means provided for lubrication.

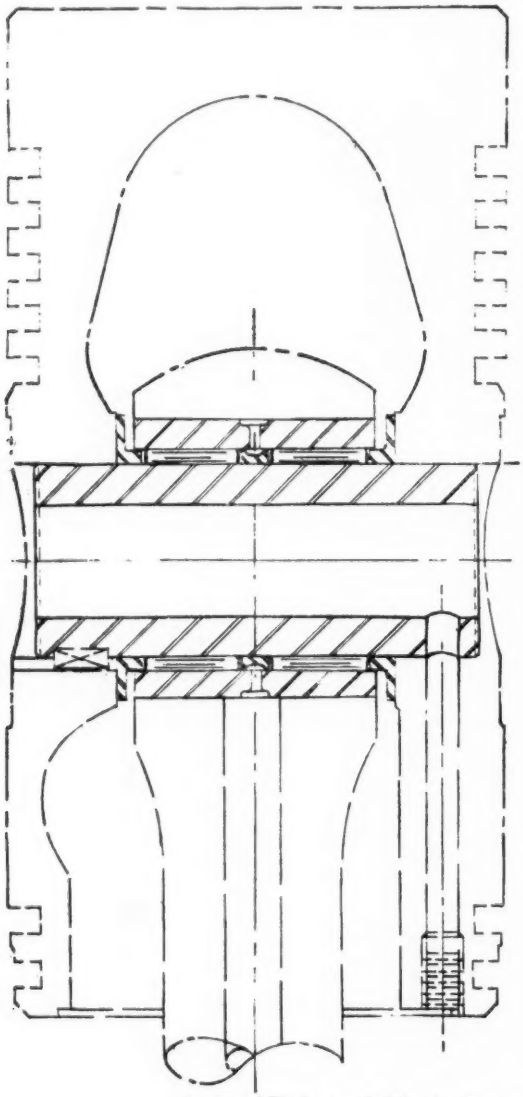
to study the operating temperatures in conjunction with the proposed consistency. The means of application also requires consideration. In other words, where a pressure gun fitting is attached for periodic renewal of lubricant, care must be taken (as in any ball or roller bearing) never to overcharge the bearing. Otherwise, marked increase in power consumption may develop with the possibility of churning and temperature rise.

With certain types of grease abnormal increase in temperature may cause sufficient decrease in body to result in separation of the oil from the soap, thereby causing marked reduction in lubricating value; leakage of oil will also be very apt to occur if the bearing has not been designed to retain oil, or if the seals are worn.

Overheated bearings will also be deceptive to some operators who may judge that the difficulty is due to lack of lubrication. Normally, addition of more grease, under such conditions, unless there is positive indication of lack of lubrication, will only tend to aggravate matters. There will also be danger of loss of lubricant and a sloppy condition around the bearing due to some of this excess grease being forced past the seals. In certain installations where perishable products are

being handled, this might in turn cause considerable monetary loss due to contamination.

For this reason, the operator who is dealing with the needle or quill type bearing must realize that this bearing, just as the more conventional type of roller or ball bearing, has but a limited capacity for grease which should never be exceeded. Unfortunately there is no practical method of accurately determining just how much grease is in any such bearing during operation. Nor is it always practicable to employ vents for control of the amount of grease added at any time. On the other hand, considerable study has been given to development of measuring devices for use in connection with pressure lubricators, to enable the application of a pre-determined amount of grease according to the known capacity of the bearing.



Courtesy of The Bantam Ball Bearing Company

Fig. 11—The Bantam Type of Quill Bearing has been proved adaptable to Diesel Engine piston pin service. Lubrication of such an installation is accomplished by leading oil to the bearing from the engine circulating system.

Lubricant Characteristics

The area of contact in the needle or quill type bearing is equally as low, in contrast with the sleeve-type bearing, as it is in the more conventional roller bearing. For this reason the presence of abrasive foreign matter in the lubricant may become a serious detriment to free rotation of the bearing elements, and the cause of wear and ultimate bearing failures. In consequence not only must we consider the original physical characteristics of any lubricant intended for such bearings, but likewise, the cleanliness of the surroundings, or the adjacent machine parts. It is obvious that in wrist pin installations, abrasive matter circulated with the oil and perhaps picked up out of a dirty crankcase, might cause premature wear and noisy operation and even serious and costly damage. In such an installation the cleanliness of the crankcase and lubricating system in general is equally as important as the original purity of the oil. Fortunately this is thoroughly realized by the majority of thoughtful operators, who regard engine flushing as a most necessary adjunct to subsequently effective lubrication.

In the grease lubricated bearing, however, one becomes more concerned with each installation as a unit. Here the one charge of lubricant must function for a considerable period of time without renewal. As a result, the presence of any appreciable amount of foreign abrasive or non-lubricating matter may lead to wear dependent on the type of motion. Reciprocating mechanisms will often be more seriously affected in this regard than those subjected to complete rotation due to the limited areas of contact under load. The fineness of the abrasive will also influence pitting of the bearing surfaces, in the opinion of certain authorities who feel that this will normally be more prevalent where coarser materials are present. Pitting, however, may also be due to acid reaction.

All this has led to acceptance of the requirement that any grease for anti-friction bearing service should be as free as possible from acid-forming tendencies in order to insure adequate protection of the highly polished metallic surfaces. In effect this involves practical neutrality or perhaps the manufacture of a very slightly alkaline product, and of course the absence of all non-lubricating fillers. The presence of any material that might cause oxidation and the development of free acidity, or lead to decomposition or oil separation is also prohibited. Properly compounded products will meet these requirements satisfactorily under normal conditions of operation, and they should indicate practically no tendency to cause corrosion or pitting of the bearing parts.

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